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ABSTRACT

Information on the Association of Research Libraries (ARL) data survey is presented, along with a quantitative index for the university libraries of the Association of American Universities (AAU). Ten quantitative measures of holdings, expenditures, and staff size for the AAU libraries from the 1981-1982 annual ARL survey are converted to an index of summary size, distributing these AAU libraries along a normal curve. The index permits quantitative comparisons of academic libraries, singly and as a group, with other academic libraries. Through factor analysis, 10 variables emerge as characteristic of AAU library size: volumes held, volumes added (gross), microform units held, current serials received, expenditures for library materials, expenditures for binding, total salary and wage expenditures, other operating expenditures, number of professional staff, and number of nonprofessional staff. Component score coefficients or weights for the 1981-1982 AAU academic library data are shown, along with the calculation of a library's 1981-1982 index score. The index scores for 52 academic libraries are provided. Information is included on the specific quantitative measures for the libraries. (SW)

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A 1981-82 INDEX FOR AAU LIBRARIES

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This paper was presented at the Twenty-Fourth Annual Forum of the Association for Institutional Research held at the Hyatt-Regency in Fort Worth, Texas, May 6-9, 1984. This paper was reviewed by the AIR Forum Publications Committee and was judged to be of high quality and of interest to others concerned with the research of higher education. It has therefore been selected to be included in the ERIC Collection of Forum papers.

Daniel R. Coleman, Chairman
Forum Publication
Advisory Committee

A 1981-82 INDEX FOR AAU LIBRARIES

ABSTRACT: Ten quantitative measures of holdings, expenditures, and staff size for the AAU libraries, as reported on the Association of Research Libraries (ARL) 1981-82 annual survey, are converted to an index of summary size, distributing these AAU libraries along a normal curve. The scores are in no way a qualitative assessment of collections, services, or operations of these libraries.

INTRODUCTION AND PERSPECTIVES

There is a considerable amount of statistical information about libraries, but for the most part it is not well known outside the library profession. The purpose of this paper is to introduce institutional researchers to the Association of Research Libraries (ARL) data survey, and to prepare from the 1981-82 data file a quantitative index for the university libraries of the AAU universities.

REVIEW OF THE LITERATURE

There are several places to learn about sources and activities relating to library statistics. The Bowker Annual of the Library and Book Trade Industry (8,11) regularly includes a section on library research and statistics. One component is an overview of current activities on research on libraries and librarianship. A special report on developments in library statistical activities frequently appears.

Whitley (15) has compiled a synopsis of national, regional, state, and specialized library data collection efforts and lists. International data exchange systems are also developing.

The federal government collects library data. Shick (11) traces the development of American library statistics by the federal government, noting three distinct periods: 1870-1937; 1938-65, characterized by a separate library unit of the U.S. Office of Education, and 1965-1983, characterized by NCES activities.

The National Center for Education Statistics (NCES) surveys academic libraries, usually biennially, as part of the Higher Education General Information Survey (HEGIS). The most recent survey was done for the year 1981-82 but the data have not yet been released. The most recent published NCES survey for academic libraries, Library Statistics of Colleges and Universities, covers the years 1978-79, was released in 1982 and includes data on 2,945 institutions.

The 1970s brought increased interest in various aspects of library statistics. In recent years there has been an appreciable increase in both the interest and activity in library statistics. Neely (8) gives reasons as increased sophistication and statistical training among librarians, and demands for accountability and the desire for better internal management decisions. He also notes that comparative statistics of similar libraries, as well as longitudinal data on an individual institution, can be strong allies in justifying budget requests -- or perhaps more often -- useful weapons in forestalling budget cuts.

THE ARL DATA FILE

Academic libraries collect and share their own data. Although not well known outside the library field, the Association of Research Libraries (ARL) statistics are the most widely recognized source of statistical information on large academic libraries in North America (2,6,10,14,15). The survey provides annual information on collection size and characteristics, staff size and characteristics, expenditures, and library use. For the years 1919-20 through 1961-62 the Princeton University Library annually issued statistics of major research libraries. Since 1961-62 the ARL has resumed responsibility for the series and continues it to the present time.

The Association of College and Research Libraries (ACRL) periodically conducts surveys of its own members. Of relevance to this study was their 1981-82 survey, which utilized the ARL instrument and obtained consistent information from ninety-two libraries in Ph.D.-granting institutions in the United States and Canada which do not belong to ARL. The availability of this data permitted merging of the data on the four AAU institutions which are not ARL members - Catholic University, Carnegie-Mellon, California Institute of Technology, and Clark University - with the 1981-82 ARL data file and subsequent analysis.

A number of authors have written on the issue of the quality of the ARL data (2,4,7,8,9,10,11,12,13,14). Early writers stressed the lack of precision in definitions (4,9,10,12); many of their concerns have now been addressed in a library data collection handbook recently released by the American Library Association (6).

The introduction to Stubbs and Buston's 1962-63 to 1978-79 cumulative report provides an excellent overview of the data quality issues (12). Among the major validity problems are uncertainty in what to include in a "volume"; where to place government documents and monographic serials; and inclusion or exclusion of libraries separate from the main campus. Law and medical libraries especially have tended to move into and out of reported counts. Fringe benefits should be

excluded from personnel expenditures, but the institution is left to define for itself what constitutes "professional" status and how to define FTE staff.

Piternick (9) notes that figures often suggest far greater accuracy of count in collection components than is justified. He also notes that, although the ARL data are replete with footnotes and qualifiers, these are for the most part ignored in subsequent analyses.

The safety with which inferences may be drawn from the figures is greatest when single libraries are studied over a short period time. It is much smaller when different libraries are compared or when the characteristics of the entire population are summarized over lengthy time periods, or predictions about them made.

DeGennaro (2) points out the wide usage of the ARL rankings by librarians, but notes that there are no correlations between the size of a library's expenditures, collections, or staff, and the effectiveness of its services or the degree of user satisfaction.

METHODOLOGY

The data tables in the 1981-82 annual issue of ARL Statistics, published by the Association of Research Libraries, display figures reported by ARL member libraries in 22 categories that, with the exception of measures of interlibrary loan activity, describe the size of ARL libraries in terms of holdings, expenditures, and personnel. Forty-eight of the 52 AAU institutions are included in this group.

For the year 1981-82 the Association of College Research Libraries (ACRL), using the ARL survey format, collected data from 92 libraries in Ph.D.-granting institutions in the United States and Canada which do not belong to ARL. Data on the four AAU institutions which are not ARL Members -- Catholic University, California Institute of Technology, Carnegie-Melon, and Clark University -- were merged with the ARL file to create the AAU library index file for 1981-82.

The library index has been derived as a means of providing a summary characterization, permitting quantitative comparisons of academic libraries, singly and as a group, with other academic libraries. Through factor analysis it can be determined that fifteen of the variables are more closely correlated with each other than with other categories. Within this group of fifteen variables, some are subsets or combinations of others. For example, expenditures for serials are a subset of expenditures for library materials. When the subsets and combinations are eliminated, ten variables emerge as characteristic of AAU library

size. These are: (1) volumes held; (2) volumes added (gross); (3) microform units held; (4) current serials received; (5) expenditures for library materials; (6) expenditures for binding; (7) total salary and wage expenditures; (8) other operating expenditures; (9) number of professional staff; and (10) number of nonprofessional staff.

These ten categories delineate an underlying factor of library size. By means of principal component analysis, it is possible to calculate the correlations of each of the variables with the hypothetical factor of library size. From this analysis, a weight for each variable can be determined, based upon how closely that variable is correlated with the overall dimension of library size defined by all ten categories. A high correlation indicates that much of the variation in AAU library size is accounted for by the variable in question, implying a characteristic in which AAU libraries are relatively alike. The component score coefficients, or weights, for the 1981-82 AAU academic library data are:

Volumes held	0.11041
Volumes added (gross)	0.10978
Microforms held	0.09521
Current serials received	0.11067
Expenditures, library materials	0.11197
Expenditures for binding	0.09950
Expenditures for salaries and wages	0.11359
Other operating expenditures	0.09896
Number of professional staff	0.11217
Number of nonprofessional staff	0.11084

From these weights an individual library can compute an index score that will indicate its relative position among AAU libraries with respect to the overall factor of library size. The data for each of the ten variables were converted to standard normal form and multiplied by the appropriate weight. The resulting scores are expressed in terms of the number of standard deviations above or below the mean index score for AAU academic libraries.

The formula for calculating a library's 1981-82 index score is:

+ .11041 (log of volumes held - 6.3995)/0.2871
+ .10978 (log of volumes added gross - 4.8403)/0.3027
+ .09521 (log of microforms - 6.1150)/0.3227
+ .11067 (log of current serials - 4.4112)/0.3285
+ .11197 (log of exp. for materials - 6.3369)/0.2368
+ .09950 (log of exp. for binding - 5.1429)/0.2861
+ .11359 (log of total salaries - 6.5898)/0.3067
+ .09896 (log of total operating expenses - 5.8610)/0.3267
+ .11217 (log of professional staff - 1.8822)/0.2683
+ .11084 (log of nonprofessional staff - 2.1846)/0.2881

AAU LIBRARY INDEX, 1981-82

RANK	LIBRARY	SCORE
1.	Harvard	1.84
2.	Calif., Berkeley	1.47
3.	Calif., Los Angeles	1.30
4.	Yale	1.21
5.	Stanford	1.16
6.	Toronto	1.13
7.	Michigan	1.06
8.	Texas	1.05
9.	Columbia	0.91
10.	Illinois	0.91
11.	Cornell	0.86
12.	Wisconsin	0.82
13.	Washington	0.63
14.	Minnesota	0.63
15.	North Carolina	0.55
16.	Ohio State	0.44
17.	Indiana	0.44
18.	Chicago	0.37
19.	Princeton	0.37
20.	Pennsylvania State	0.37
21.	New York	0.30
22.	Virginia	0.30
23.	Pennsylvania	0.29
24.	Duke	0.17
25.	Northwestern	0.12
26.	Southern California	0.10
27.	Michigan State	0.08
28.	Kansas	-0.03
29.	Pittsburgh	-0.07
30.	Iowa	-0.11
31.	Calif., San Diego	-0.13
32.	Maryland	-0.14
33.	McGill	-0.22
34.	Syracuse	-0.28
35.	MIT	-0.30
36.	Johns Hopkins	-0.30
37.	Missouri	-0.31
38.	Washington U-St. Louis	-0.32
39.	Purdue	-0.46
40.	Nebraska	-0.47
41.	Brown	-0.51
42.	Colorado	-0.52
43.	Vanderbilt	-0.53
44.	Iowa State	-0.56
45.	Rochester	-0.66
46.	Oregon	-0.81
47.	Tulane	-0.87
48.	Case Western Reserve	-1.03
49.	Catholic	-2.01
50.	California Inst. of Tech	-2.45
51.	Carnegie-Mellon	-2.45
52.	Clark	-3.35

The index scores for 1981-82 for the AAU academic libraries are given as Table I. It is important to emphasize that these scores are only a summary description of library size, distributing AAU libraries along a normal curve, based on ten quantitative measures that are in no way a qualitative assessment of the collections, services, or operations of these libraries.

RESULTS AND CONCLUSIONS

In terms of size the resources deployed, the AAU libraries are clearly the elite of U.S. academic libraries. Together they have over 150 million volumes and 1.7 million serials. They spend nearly half a billion dollars annually; they add over 4 million volumes to their collections each year, and they employ 14,000 FTE staff members.

The AAU libraries are not a completely homogenous group, however. Four of the libraries -- Catholic, California Institute of Technology, Carnegie-Mellon, and Clark -- are quantitatively different from the other AAU libraries. The reader will note that these four have component scores of -2.0 or lower. The component scores are approximately normal; in a normal distribution a score of -2.0 is equivalent to a probablity of 2%. It can therefore be said that the probability is 2% or less that Catholic, California Technology, Carnegie-Mellon, and Clark are quantitatively similar to the other AAU libraries.

At the other end of the scale, Harvard's score of 1.83 means that there is only about a 3% chance that Harvard is similar to the others. These conclusions are merely one way of verifying what can be seen by inspection of the data. Forty-eight of the AAU libraries have one million volumes or more, while Catholic, California Technology, Carnegie-Mellon, and Clark each has 600,000 or fewer. The other libraries have more than 120 staff and spend almost $4 million or more, while the latter four have fewer than 70 staff and $2 million or less in expenditures.

One of the interesting facts is the sums of the AAU libraries in the various categories of expenditure:

Category	Expenditure	% of Total
Expenditures, library materials	$127,721,841	30%
Expenditures, binding	8,790,827	2%
Total salaries & wages	247,405,792	57%
Other operating expenditures	47,659,949	11%
Total expenditures	$431,578,409	100%

Very roughly, four-sevenths of expenditures to go personnel, two-sevenths to library materials, and one-seventh to binding and

operating expenditures. In other words, AAU library expenditures are allocated approximately in the proportions 4:2:1.

Regression analysis offers a way of seeing how expenditures are related to other variables in the data. For example, there is a remarkable uniformity among AAU libraries in the relation between volumes held and professional staff. The regression equation is

professional staff = .0000232 x vols. + 18.4,

with an R^2 of .88. The factor ".0000232 x vols." is approximately equal to one professional for each 43,000 volumes held. So the equation becomes

professional staff = 1 for each 43,000 vols. + 18.

Each AAU library had 18 professionals plus one for each 43,000 volumes held. A library with 4,300,000 volumes would be expected to have 18 + 4,300,000/43,000 = 118 professionals.

It has been shown that nearly 90% of the expenditures are for (1) library materials, and (2) total salary and wages. Some regression equations that allow us to predict the main categories of expenditures are:

(1) Professional staff = 1 for each 43,000 + 18 (R^2 = .88)

(2) Expenditures for library materials = $.50 for each volume held plus $900,000 ($R^2$ = .75)

(3) Total salaries and wages = $56,000 for each professional - $220,000 ($R^2$ = .87)

(4) Total expenditures = $88,000 for each professional + $430,000 ($R^2$ = .88)

If it is known how many volumes an AAU library had in 1981-82, it can be very accurately predicted how many professional librarians were on its staff. We can then use the numbers of volumes and the number of professionals to make accurate prediction of both total library expenditures and also the major categories of expenditure. For example, multiplying the number of professionals by $88,000 and adding $430,000 can give a reasonably good estimate of the library's total expenditures. These estimates are not as good, nowever, for Catholic, California Technology, Carnegie-Mellon, and Clark, as for the other 48 AAU libraries.

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1981-1982 AAU LIBRARY DATA
(INCLUDING PRINCIPAL COMPONENT SCORES)

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ANK	LIBRARY	SCORES	VOLUMES HELD	VOLUMES ADDED, GROSS	CURRENT SERIALS	EXPEND. FOR LIBRARY MATERIALS	TOTAL SALARIES	TOTAL LIBRARY EXPEND.	PROF. STAFF	NONPROF. STAFF	TOTAL STAFF
1	HARVARD	1.8382	10,409,228	185,775	97,000	$5,782,416	$12,930,744	$21,082,717	279	523	802
2	CALIF.,BERKELEY	1.4664	6,117,424	209,264	102,265	$4,169,260	$11,670,545	$18,339,328	146	305	451
3	CALIF.,LOS ANGELES	1.2990	4,882,164	129,933	69,548	$4,195,060	$10,779,342	$18,685,828	149	240	389
4	YALE	1.2079	7,725,424	161,097	57,679	$3,425,883	$8,331,627	$14,208,040	179	386	565
5	STANFORD	1.1602	4,889,448	137,403	46,455	$4,732,935	$9,875,649	$16,640,416	145	344	489
6	TORONTO	1.1286	4,789,740	199,755	44,007	$4,037,714	$10,740,980	$16,147,563	162	500	662
7	MICHIGAN	1.0550	5,481,172	126,911	60,688	$3,677,902	$7,516,157	$12,788,512	141	309	450
8	TEXAS	1.0479	4,846,764	159,155	60,000	$4,847,047	$7,587,294	$13,879,151	133	360	493
9	COLUMBIA	0.9120	5,192,448	99,053	59,604	$2,989,091	$7,624,639	$11,920,301	137	280	417
10	ILLINOIS	0.9081	6,242,615	172,676	93,913	$4,019,841	$6,666,517	$11,811,224	112	296	408
11	CORNELL	0.8551	4,401,660	109,564	54,643	$3,157,799	$5,928,458	$10,725,269	140	258	398
12	WISCONSIN	0.8208	4,173,215	113,953	53,836	$3,352,060	$6,815,220	$11,877,013	135	236	371
13	WASHINGTON	0.6349	4,084,741	133,880	40,698	$2,750,266	$6,008,284	$9,408,286	115	228	343
14	MINNESOTA	0.6265	3,945,397	82,937	47,032	$3,010,551	$6,875,630	$11,290,754	123	177	300
15	NORTH CAROLINA	0.5523	2,839,858	123,940	39,593	$3,520,990	$4,945,302	$9,599,908	105	180	285
16	OHIO STATE	0.4413	3,685,917	84,726	28,591	$2,756,128	$5,466,618	$9,776,569	100	207	307
17	INDIANA	0.4382	3,993,390	162,884	27,589	$2,722,608	$5,360,880	$8,988,614	104	203	307
18	CHICAGO	0.3750	4,565,591	132,269	47,419	$2,004,950	$4,380,778	$7,819,811	74	156	230
19	PRINCETON	0.3675	3,430,242	72,843	30,927	$2,898,532	$5,377,077	$9,181,191	95	228	323
20	PENNSYLVANIA STATE	0.3672	2,272,980	82,607	22,735	$2,607,972	$5,593,252	$9,417,339	97	255	352
21	NEW YORK	0.2990	2,698,871	89,290	27,925	$2,345,301	$4,840,161	$8,469,884	92	182	274
22	VIRGINIA	0.2978	2,466,753	90,164	25,003	$2,693,004	$4,415,944	$8,190,114	86	197	283
23	PENNSYLVANIA	0.2890	3,054,234	71,135	30,971	$1,915,557	$4,750,748	$7,932,783	92	152	244
24	DUKE	0.1697	2,084,412	79,464	29,126	$2,533,703	$4,098,134	$8,051,588	83	162	245
25	NORTHWESTERN	0.1181	2,889,402	75,707	32,606	$2,244,989	$4,780,315	$7,830,819	99	154	253
26	SOUTHERN CALIFORNIA	0.1031	2,170,774	76,293	33,021	$2,525,300	$4,199,694	$7,784,422	87	140	227

1981-1982 AAU LIBRARY DATA
(INCLUDING PRINCIPAL COMPONENT SCORES)

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RANK	LIBRARY	SCORES	VOLUMES HELD	VOLUMES ADDED, GROSS	CURRENT SERIALS	EXPEND. FOR LIBRARY MATERIALS	TOTAL SALARIES	TOTAL LIBRARY EXPEND.	PROF. STAFF	NONPROF. STAFF	TOTAL STAFF
27	MICHIGAN STATE	0.0754	2,807,156	105,928	20,301	$2,296,850	$3,917,646	$7,172,379	69	120	189
28	KANSAS	-0.0273	2,251,917	65,125	27,812	$2,603,008	$3,578,659	$7,126,947	80	132	212
29	PITTSBURGH	-0.0685	2,386,504	70,833	17,702	$1,949,305	$3,941,781	$6,496,285	81	164	245
30	IOWA	-0.1125	2,412,577	64,437	29,891	$2,794,902	$3,299,971	$6,543,913	72	97	169
31	CALIF.,SAN DIEGO	-0.1269	1,507,875	59,955	27,904	$2,248,442	$4,264,153	$7,407,604	55	156	211
32	MARYLAND	-0.1352	1,516,990	62,969	19,632	$2,199,359	$3,951,840	$6,722,941	82	151	233
33	MCGILL	-0.2221	2,127,348	70,939	14,802	$1,684,986	$5,526,192	$7,787,967	79	235	314
34	SYRACUSE	-0.2755	2,010,089	71,532	23,430	$1,669,356	$2,722,169	$5,094,536	62	139	201
35	MIT	-0.2956	1,869,173	55,643	19,843	$1,598,201	$3,417,969	$5,748,851	76	152	228
36	JOHNS HOPKINS	-0.2979	2,369,926	36,101	19,541	$1,988,897	$2,856,873	$6,311,412	63	147	210
37	MISSOURI	-0.3071	2,117,156	56,635	21,588	$1,873,419	$2,338,918	$4,786,262	52	106	158
38	WASHINGTON U-ST. LOUIS	-0.3217	1,883,737	47,950	15,558	$1,829,571	$2,566,808	$5,862,386	66	117	183
39	PURDUE	-0.4643	1,503,098	44,965	17,755	$1,766,215	$3,204,861	$5,567,430	42	182	224
40	NEBRASKA	-0.4678	1,602,671	57,014	20,859	$1,757,449	$2,312,696	$4,723,802	54	108	162
41	BROWN	-0.5111	1,804,982	43,265	14,251	$1,590,306	$2,605,305	$5,290,754	67	99	166
42	COLORADO	-0.5160	1,927,699	43,941	19,441	$1,730,097	$2,739,438	$4,870,206	43	101	144
43	VANDERBILT	-0.5268	1,483,428	41,477	16,315	$1,617,705	$2,351,223	$5,326,817	53	105	158
44	IOWA STATE	-0.5613	1,447,350	50,271	20,054	$1,94[illegible]711	$2,536,389	$4,894,573	46	105	151
45	ROCHESTER	-0.6612	1,871,675	42,058	14,953	$1,157,123	$2,462,488	$4,094,382	52	97	149
46	OREGON	-0.8100	1,540,340	38,931	20,300	$1,762,767	$2,186,581	$4,330,821	46	82	128
47	TULANE	-0.8680	1,427,366	28,888	12,518	$1,368,797	$1,972,873	$3,825,637	47	89	136
48	CASE WESTERN RESERVE	-1.0316	1,410,669	22,590	13,404	$1,140,941	$2,132,216	$3,781,159	65	81	146
49	CATHOLIC	-2.0056	1,136,953	15,808	7,758	$618,308	$1,108,691	$2,024,569	25	43	68
50	CALIF. INST. OF TECH.	-2.4438	364,352	10,045	5,664	$697,436	$740,868	$1,605,834	14	35	49
51	CARNEGIE-MELLON	-2.4494	618,790	10,789	2,831	$668,226	$721,426	$1,623,316	23	31	54
52	CLARK	-3.3469	420,977	11,953	2,719	$326,483	$367,569	$798,182	9	17	26